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IS: 7799 - 1975

Indian Standard
CODE FOR PRESERVATION OF
VITAMINS IN FOODSTUFFS

UDC 664.8/9:577.16.04



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INDIAN STANDARDS INSTITUTION

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI 110002



Gr 3

Price Rs 5.00

December 1975

Indian Standard

CODE FOR PRESERVATION OF VITAMINS IN FOODSTUFFS

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Indian Standard

CODE FOR PRESERVATION OF VITAMINS IN FOODSTUFFS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 September 1975, after the draft finalized by the Food Hygiene, Sampling and Analysis Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Vitamins are organic compounds present in small amounts in natural foodstuffs and are essential for health. They are broadly classified into two groups, namely, fat soluble and water soluble. Vitamins A, D, E and K are fat soluble while the vitamins B complex and C are water soluble. These vitamins are affected by the various processes to which foodstuffs are subjected from the time of harvesting until they are consumed. Loss of vitamins during handling, transport and processing is generally a result of their sensitivity to oxygen, light, heat and the pH of the medium during processing. Any method of preparation that disturbs the natural cell organization, such as peeling, chopping, cutting, etc, tends to increase the losses. Presence of some of the trace elements like iron and copper may also catalyse the loss of vitamins.

0.3 In this code an attempt has been made to suggest ways of preservation of vitamins during various processes to which foodstuffs are subjected. Adherence to the practices suggested in this code will help conserve a considerable amount of vitamins contained in foods which otherwise go waste. This will also help in educating the consumers and manufacturers for better utilization of available nutrients contained in foods.

1. SCOPE

1.1 This standard prescribes conditions and practices of handling, transport, processing, packaging and storage of foodstuffs for preservation of vitamins contained or inherently present in them.

2. GENERAL CHARACTERISTICS OF VITAMINS

2.1 Fat-Soluble Vitamins

2.1.1 *Carotene and Vitamin A (Retinol)* — Stable under inert atmosphere, but loses activity when heated in the presence of oxygen; completely destroyed when oxidized, dehydrated or dehydrogenated; more sensitive to ultraviolet than other wavelengths of light. It is stable at neutral and alkaline pH, but unstable in acid medium. It is oxidized by fat pyrooxidases and in presence of traces of copper.

2.1.2 Vitamin D—Stable in neutral and acidic pH; unstable in alkaline pH, and sensitive to air, light and heat. Vitamin D crystals are stable when stored in amber glass bottles. No loss occurs through processing and storage.

2.1.3 Vitamin E (Tocopherol)—Stable to vigorous boiling in acid in the absence of oxygen, and quite stable to visible light, but unstable at room temperature in the presence of oxygen, alkalis, ferric salts and ultraviolet light. Esters of tocopherols are more stable than the free forms.

2.1.4 Vitamin K—Stable to heat and reducing agents but sensitive to alcoholic alkali, oxidizing agents, strong acids and light.

2.2 Water-Soluble Vitamins

2.2.1 Thiamine (Vitamin B₁)—Stable in acid medium, but unstable in air especially at alkaline pH and high temperature; destroyed by addition of alkalis and food preservative like sulphites, and by autoclaving, baking and roasting (10 to 15 percent).

2.2.2 Riboflavin (Vitamin B₂)—Sensitive to light, and rate of destruction increases with a rise in pH and increase in temperature. Stable to heat if in dry form, or in acid medium.

2.2.3 Niacin (Nicotinic Acid)—Nicotinamide is partially hydrolyzed by alkali but the resulting nicotinic acid has the same biological activity. Nicotinic acid is generally stable to air, light, heat, acids and alkalis. It is released by lengthening baking time, time of treatment, heat and pressure.

2.2.4 Pantothenic Acid—Most stable between pH 5.5 and 7.0; is rapidly hydrolyzed under stronger acidic or alkaline conditions. It is sensitive to dry heat, hot acid and hot alkali but unaffected by light and air.

2.2.5 Pyridoxine, Pyridoxal and Pyridoxamine (Vitamin B₆)—All the three forms are sensitive to ultraviolet light when in neutral or alkaline solution. These are not very stable to heat and are destroyed by exposure to heat, light and alkaline solution.

2.2.6 Folic Acid—Stable during boiling at pH 8 for 30 minutes, yet large losses occur during autoclaving in acids and alkalis. This destruction is accelerated by oxygen and light.

2.2.7 Cobalamin (Vitamin B₁₂)—Stable in neutral pH, acid and alkali, as well as heat, but sensitive to air, oxygen and light.

2.2.8 Ascorbic Acid (Vitamin C)—Fairly stable in acid solution, but decomposes in light. The decomposition is accelerated by the presence of alkalis, oxygen, copper and iron. Unstable to heat. It is a particularly sensitive vitamin and is easily destroyed.

3. PRESERVATION OF VITAMINS DURING PREPARATION FOR COOKING AND PROCESSING

3.1 Selection, Handling and Preparation of Fresh Vegetables

3.1.1 Green vegetables should be obtained as fresh as possible and should be used as early as possible. Leafy green vegetables, when refrigerated, retain more than 90 percent of the vitamin C and vitamin A value for 24 hours. Levels of these nutrients drop to 75 percent after storage for several days. Fresh green vegetables lose much vitamin C even in a day or two when stored at room temperature. For example, spinach may lose three-quarters of its vitamin C in two days.

3.1.2 Leafy green vegetables should be kept in a cool and damp place to reduce wilting, as dry heat results in serious losses of vitamin C in succulent vegetables.

3.1.3 Precautions should be taken to avoid damage through crushing or bruising during handling, transport and storage.

3.1.4 Vegetables should be washed before peeling and cutting and not after. Washing and soaking after peeling or cutting results in a loss of water-soluble vitamins.

3.1.5 Peeling should be done thin rather than thick since removal of thick peelings results in a proportional loss of vitamins.

3.1.6 Vegetables should be cut into large pieces rather than small so that less surface-area is exposed to the atmosphere for oxidation. Vegetables should be cut and sliced immediately before cooking. Exposing cut vegetables to strong sunlight gradually destroys vitamins.

3.1.7 Vegetables for salads should be shredded or finely chopped just before serving to conserve vitamin C.

3.1.8 Green peas, beans and other immature seeds retain vitamin C to a greater extent when they are present in their pods rather than when shelled. Similarly cabbage in a solid head will retain its vitamins longer than a cabbage pre-shredded.

3.1.9 The dark green outer leaves of cabbage, lettuce, etc, are very rich in vitamin A. So are the green tops of vegetables like the radish, beet root, carrot, knol khol, etc. In preparing such vegetables, these highly nutritious portions should not be thrown away. Cabbage shredded with a sharp knife will retain vitamin C longer than cabbage cut on shredder or with a dull knife.

3.2 Selection, Handling and Preparation of Fruits

3.2.1 Fruits should be washed before cutting; soaking or washing after peeling and cutting results in a loss of water-soluble vitamins.

3.2.2 Fruits should be cut into bigger pieces as with small pieces a greater area is exposed to atmospheric oxidation. Exposure to sunlight destroys many vitamins.

3.2.3 Fruits should be cut and peeled immediately before processing or serving.

4. PRESERVATION OF VITAMINS DURING HOME-COOKING OF FOODS

4.1 General Considerations

4.1.1 Use a pan with a flat bottom, a tight-fitting lid, diameter suited to the size of the heat source and volume suited to the amount of the food being prepared.

4.1.2 Certain methods of cooking also conserve vitamins. Roasting of food materials, such as coffee and fenugreek seeds increase both the free and total niacin in the product. Pressure cooking conserves the vitamins present in foodstuffs.

4.1.3 A good home practice is to utilize and not throw away the fluid portions of the contents of canned foods, since these contain large percentages of the water-soluble vitamins.

4.1.4 If frozen foods are to be cooked before serving, these should not be defrosted earlier but only just before the cooking to protect flavour, appearance and food value. Frozen fruits to be served without cooking should be defrosted as close to the time of serving as possible.

4.1.5 Water-soluble vitamins are more stable in the presence of acid. Vinegar and tamarind water can, therefore, be added with advantage during cooking or preservation. Addition of alkali or sodium bicarbonate hastens destruction of these vitamins.

4.1.6 Steeping of fresh vegetables in water for long time should be avoided. A minimum lapse of time between harvesting and cooking or processing and serving is essential to get the highest nutritive value out of vegetables.

4.2 Green Vegetables — The following guidelines should be adhered to while cooking vegetables.

4.2.1 The water-soluble vitamins diffuse out when vegetables are boiled; the more the water the more serious will this loss be. Leafy vegetables cooked in just enough water will lose only half as much vitamins B and C as when these are cooked in an excessive amount of water. Therefore, use the smallest possible amount of water for cooking. In fact green leafy vegetables should be cooked in their own water content. Keep the water boiling before adding vegetables. Add salt to water before adding vegetables. Water-soluble vitamins keep remarkably well in frozen foods. Sulphur dioxide is useful in protecting the vitamins

4.2.2 Add vegetables a little at a time so as to keep water constantly boiling. If vegetables are put into cold water, the destruction of vitamins is accelerated during the short interval before the water is brought to a boil. Cook vegetables no longer than is necessary to make them tender. The longer a vegetable is cooked the greater will be the destruction of vitamins. Seasonings like butter, sauce, etc, should usually be added at the end of the cooking period.

4.2.3 Fry vegetables briskly in a small quantity of hot oil and a tea-spoonful of salt. Add a small quantity of boiling water and let it stand for a short period in a closed container. Keep the lid on so that no steam escapes. When the vegetables are cooked, only very little water should be left, most of it having been absorbed.

4.2.4 If after cooking there is water left which is not needed for a particular preparation, use this water either for cooking the next batch or use it for preparation of soups or gravies, or use it for kneading dough for *CHAPATI*. This helps to utilize valuable vitamins and minerals present in green vegetables.

4.2.5 Plan cooking so that vegetables are served immediately after these are cooked. Do not allow cooked vegetables to stand on a hot plate or fire for long time. Keeping vegetables hot after these have been cooked greatly reduces the amount of vitamins these contain. In fact losses occur even when stored at room temperature or in refrigerator. The loss of vitamins in most of the cooked vegetables is considerable.

4.3 Cooking of Rice

4.3.1 *Washing* — As far as possible, washing of rice should be avoided. Washing removes thiamine, riboflavin and niacin. Alkaline water enhances the loss of vitamins.

4.3.2 *Parboiling* — Parboiled rice contains 3 to 4 times as much vitamins as raw rice of the same variety milled and processed to the same degree. Hence its use is nutritionally advantageous. Less of vitamins are lost during washing of parboiled rice.

4.3.3 *Draining of Cooked Rice* — Approximately 25 percent of the vitamins of rice is diffused out with cooking water. The combined effect of processing, washing and cooking of the polished rice leads to a nearly complete loss of vitamins, while parboiled rice, still retains most of these vitamins even when the cooking water is discarded.

4.4 *Sprouting* — Germination of pulses in general enhances the vitamin content especially vitamins of B group, C and E. It is recommended that pulses should be consumed after sprouting.

4.5 Fermentation — Fermentation of foods for the preparation of *IDLI*, *DOSA*, *DHOBELA*, *KHAMAN*, etc, results in a substantial increase in vitamins of B group.

4.6 Pickling — Pickling of fruits and vegetables also preserves considerable amount of vitamins. Pickled *AMLA* (Indian gooseberry) conserves vitamin C while carrots preserve vitamin A.

4.7 Baking — Baking results in a loss of considerable amount of vitamins. Some protein is also rendered unavailable.

4.8 Frying — Frying results in some loss of vitamins.

5. COMMERCIAL PROCESSING

5.1 Dehydration

5.1.1 Moderate losses of vitamins occur during dehydration. Retention of vitamins, such as carotene and vitamin C is higher in spray-dried or freeze-dried fruits or vegetables than in sun-dried.

5.1.2 Losses of vitamin C during dehydration are extensive especially in vegetables. Vitamin C is the most difficult of vitamins to preserve during dehydration and blanching of vegetables.

5.2 Canning

5.2.1 High-temperature short-time blanching is more conducive to retention of water-soluble vitamins than other procedures.

5.2.2 In products like canned citrus fruits, pineapple and tomatoes, and in the juices prepared from these fruits, vitamin C is retained in processing and storage.

5.2.3 Canning itself is not detrimental to vitamin A and carotene but losses occur during storage.

5.3 Milling — Considerable losses of vitamins occur during milling of cereals and pulses. Some vitamin-containing fractions are also lost in this operation. Whole-cereal flours (*ATTA*) are nutritionally superior as compared to milled flours (*MAIDA*). Unpolished rice contains more vitamins than polished rice.

6. STORAGE

6.1 Storage at 0°C results in slow loss of vitamins. The losses of vitamins in most foods stored at 15°C are significantly higher than storage at 0°C. At 0°C temperature, frozen vegetables lose less than 25 percent of their vitamin C content during a period of 6 to 9 months. Vitamin A and carotene contents of frozen fruits and vegetables may drop as much as 25 percent during storage at 0°C from one season to the next.

6.1.1 Most fresh vegetables and fresh ripe fruits keep well in a refrigerator. Leafy green vegetables retain more than 90 percent of their vitamin C and A value for 24 hours. Retention of these nutrients drops to 75 percent after storage for several days. Fresh green vegetables lose much of the vitamin C even in a day or two when stored at room temperature. Spinach loses three-quarters of its vitamin C in 2 days. New potatoes are considerably richer in vitamin C than old ones, because the vitamin is gradually lost during storage.

6.1.2 Under-ripe fruits should be stored at room temperature to ripen. Vitamin losses are smaller at room temperature during the time required for ripening. Fruits should be used or transferred to the refrigerator as soon as ripened. This is important to keep them in good condition as cell damage causes considerable loss of vitamin C.

6.1.3 Canned foods should be stored at low temperature in order to prevent losses in vitamins.

6.2 Storage at Room Temperature — Storage of cereals and pulses at room temperature for long time results in loss of vitamins in grains.

INDIAN STANDARDS

ON

FOOD ANALYSIS

IS:

- 5398-1968 Methods for estimation of thiamine (vitamin B₁) in foodstuffs
- 5399-1969 Methods for estimation of riboflavin (vitamin B₂) in foodstuffs
- 5400-1969 Methods for estimation of nicotinic acid (niacin) in foodstuffs
- 5401-1969 Methods for detection and estimation of coliform bacteria in foodstuffs
- 5402-1969 Method for plate count of bacteria in foodstuffs
- 5403-1969 Method for yeast and mould count in foodstuffs
- 5835-1970 Method for estimation of vitamin D in foodstuffs
- 5838-1970 Method for estimation of vitamin C in foodstuffs
- 5886-1970 Methods for estimation of carotenes and vitamin A (retinol) in foodstuffs
- 5887-1970 Method for detection of bacteria responsible for food poisoning and food-borne diseases
- 7219-1973 Method for determination of protein in foods and feeds
- 7234-1974 Method for estimation of folic acid in foodstuffs
- 7235-1974 Method for estimation of tocopherol (vitamin E) in foodstuffs
- 7529-1975 Method for estimation of vitamin B₁₂ in foodstuffs
- 7815-1975 Method for estimation of amino acids in foods